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Logistics and information technology: A coordination perspective
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ABSTRACT: Logistics is the discipline that studies the flow of goods and services, and accompanying information, within and between organizations. Coordination has been defined as the management of dependencies between activities, and offers a framework for the exchange of management techniques between disciplines by characterizing different types of dependencies and identifying the coordination structures that can be used to manage them. Logistics coordination structures consist of 2 distinct substructures that because of the information technology, can now be optimized separately: one dealing with the delivery of goods, and the other with the associated information.

TEXT: Coordination theory has been developed in order to answer a basic question: how will the widespread use of IT change the ways people work together? Improvements in IT have significantly changed how information can be processed and communicated, which in turn has led to increased interest in the study of interdependencies between organizations. Also, coordination research seeks analogies in how coordination occurs in different environments and disciplines, whether in the fields of management, economics, information processing, or the natural sciences. The interdisciplinary study of coordination is in its early phases, work is just beginning on how to model or represent processes and dependencies in a manner so that practices can be shared between disciplines. Coordination theory attempts to identify common processes that are used to manage dependencies within different fields.2 The contribution of coordination research has been explained as follows:

Research in the areas of coordination science and technology is timely for at least two reasons. First, the rapid spread of computer networks will provide an unprecedented opportunity for large numbers of people to use computers in a new way: to help coordinate their work together. We have already seen early examples of new collaborative computing tools, and many observers think this shift to "interpersonal computing" will be as important as the earlier shifts to time-sharing and personal computing.
In the long run, these new kinds of tools can do much more than just make old organizational processes faster or cheaper. In order to truly take advantage of these new technologies, we need to understand how they can be used effectively in real organizations. For example, by dramatically reducing the costs of communication and coordination, new information technologies may soon lead us across a threshold where we can create radically new and more flexible kinds of organizations.3

The research agenda that has been suggested for coordination theory has two main areas of concern. First comes the development of means of representing and classifying coordination processes. Second is the analysis of specific coordination techniques (such as those used in logistics in allocating storage space) in order to facilitate the exchange of information about these techniques between disciplines. For example, do the resource allocation techniques used in warehouse management have a parallel in how computer systems allocate their memories when processing and storing data?

Do scheduling techniques used in manufacturing have something in common with those used in vehicle fleet management? It has been suggested that coordination theory can provide "a set of abstractions that help unify questions previously considered separately in a variety of different disciplines."[4]

Increased product proliferation and the trend toward outsourcing of logistics activities have been cited as reasons for increased coordination cost and effort in logistics. For example, value-added partnerships (or strategic alliances) are an example of an ITenabled interorganizational configuration where the coordination of logistics processes between organizations is the key to good performance, as explained by Bowersox and Daugherty,[5] and Sheombar.[6] The concepts of integrated logistics management and supply chain management, which figure prominently in the logistics literature, are built on functional integration, which is supported (and to a certain extent provoked) by IT.[7] Finally, the contemporary competitive environment requires interorganizational exchange and coordination of logistics information to achieve common goals.[8]

We will introduce our research with a discussion of logistics and generic organizational coordination structures, in order to explain why a coordination theory approach for logistics structuring and organization may be of interest. We will then describe why such redesign and optimization are feasible. Given that coordination theory is based in the field of information systems, this paper represents an attempt to understand logistics based on a methodology from another discipline?

LOGISTICS TRENDS

Logistics deals with the flow and storage of goods and related information, as defined by the Council of Logistics Management:

The process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and related information from point-of-origin to point-of-consumption for the purpose of conforming to customer requirements.'o

Previously viewed as a clerical function involving adversarial relationships between suppliers, customers, and transportation providers, logistics is emerging as a key source of competitive advantage and a leading reason for the emergence of interorganizational systems.

Purchasing, inventory control, warehousing, transportation, packaging, and parts and service support are the main components of the logistics function. Many of these activities have been barriers to organizational change; however, the impact of IT is now transforming logistics into a catalyst for renewal.

About $670 billion-10.5% of GDP-is spent by U.S. firms on logistics activities," Suppliers are drastically cutting response times, intermediaries such as distributors are being eliminated or are refocusing their efforts in order to genuinely add value, and distribution is being recognized as an interorganizational process requiring the cooperation of all parties. The terms "supply chain" and "value chain" are being used to describe the IT-supported integration of logistics activities.

The major factors driving logistics include shorter product life cycles, increased product proliferation, more demanding customers with higher expectations, just-in-time manufacturing, and globalization of the marketplace.' For example, Motorola manufactures 29 million different configurations of pagers for next-day delivery anywhere in the United States.[13]

Recent innovations in IT related to logistics have emphasized using information to provide better visibility of physical goods. This approach

emphasizes the use of information as a supporting element of the value-added process, rather than as a source of value itself. However, a new, parallel virtual value chain can emerge from the physical value chain that currently defines logistics functions. The traditional, physical value chain defines the "marketplace" while the virtual value chain defines the "marketspace."4 For example, Federal Express creates value through information by providing a World Wide Web home page (http://www.fedex.com) where customers can check on the current location of a shipment by entering the waybill number. The emergence of a "marketspace" can lead to the establishment of new relationships with customers beyond those that exist in the physical world.'

CULTURAL ASPECTS

The managerial and cultural aspects of logistics are as critical as the impact of IT. While the emergence of electronic data interchange (EDI) and electronic markets would seem to permit an increase in the number of suppliers firms can do business with, the opposite trend seems more evident: firms are developing close relationships with a small number of major suppliers.16 For example, Wal-Mart's in-store inventories of items such as Tide and Crest are managed by Procter & Gamble, who have direct access to point-ofsale data. Inventories can be managed by suppliers, sometimes without any intervention by the retailer. In the retail grocery industry, the movement toward "efficient consumer response" seeks to more precisely match inventory levels at the manufacturer, distributor and retailer to actual demand. 17

Along with the reduction in the supplier base, there is an increasing emphasis on "noncontractible" criteria such as innovation, trust, and quality.ls IT is lightening the workload associated with routine logistics transactions, allowing managers to focus on broader issues that have a direct impact on competitiveness and performance. Risks (such as transaction risks and agency costs) remain a real issue: how much information should be shared with suppliers? Should suppliers provide their customers with details of their manufacturing processes? What will happen if suppliers are allowed to see information on their competitors? A final issue is the development of performance indicators and reward mechanisms for managing partnerships between producers, distributors, retailers and transportation firms. For example, buyers and suppliers may need to decide how they will share reductions in transportation and inventory costs.

THE SUPPLY CHAIN AND INFORMATION TECHNOLOGY

Improvements in IT have reduced logistics transactions costs and promoted better communications between organizations. As mentioned previously, the concept of the supply chain or value chain has emerged to support the integration of logistics activities, which include purchasing, manufacturing, distribution, and sales. Each element in the supply chain can be affected by inaccurate demand information, disturbances due to breakdown, the number of decision points where information is concentrated and acted on, time lags for value and nonvalue added processes, and decision rules for activities such as inventory levels or order placement.19 Supply chain management is the integrated management of all of these processes, and concentrates on the interfaces in order to achieve the overall strategic goals of organizations in the supply chain.

Porter has noted that "competitive advantage is increasingly a function of how well a company can manage this entire system."20 There exists a general trend toward increased integration within the supply chain in order to create better information, which in turn should support lower inventories and improved **financial performance**. But the evolution of IT and diminishing **transaction** costs will also lead to a fundamental restructuring of industry practices for distributing and supporting products.

The biggest impact of this restructuring will be on the intermediaries, such as distributors and warehouses, that handle physical goods and the information associated with them between the producer and final consumer.2' Low cost, high-bandwidth communications such as those envisaged by the U.S. Government's National Information Infrastructure project could allow customers at all points in the supply chain to share projections of their requirements, which would significantly reduce the need to manufacture and store products before consumption.
Throughout the supply chain, decisions must be made about issues such as supplier selection, price, quantity, routing and delivery, and contractual terms. Each of these decision points requires coordination to take place. Logistics activities could therefore be described as integrated systems of coordination structures governing the flow of physical goods within and between organizations.

paper w/ list of goods & shipping instructions, sent w/goods

STRUCTURES OF LOGISTICS PROCESSES

Logistics processes can be represented through graphs or flow charts, and each process can be viewed as consisting of two distinct paths or substructures: the flow of physical goods and the flow of information related to those goods, such as purchase orders, waybills, and **payments**. The nodes or decision-making points linking the points represent the different participants, such as manufacturers, warehouse operators, transportation firms, and consumers. Traditionally, the same structures have been used for both goods and information flow: the parties that handle the goods also handle the associated information.

IT now provides the opportunity to redesign logistics practices in order to take advantage of IT-enabled organizational structures. For example, delivery may take place without traversing a series of distributors if the goods are shipped directly from factory to the consumer. Within this scenario, the intermediary is a true broker, and holds no real inventory. Only the information related to the item is processed and/or stored by intermediaries. This scenario depicts one structure (a hierarchy or a centralized market) for processing of the information related to the request for a good, whereas a different structure (decentralized market) is used for the physical delivery of that item.

may deliver

For example, a consumer may order clothing from a mail-order firm such as Lands' End. The consumer deals only with a telephone sales representative working for Land's End, but the clothing is distributed to the consumer through a series of warehouses and transportation firms (such as truckload carriers, Federal Express, or the U.S. Postal Service) chosen by Land's End.

Another example would be a mail-order firm that has its inventory managed by a Federal Express subsidiary that maintains a warehouse at the Memphis airport. Fedex takes care of distribution, while the selling firm deals with the customer and transmits shipping information electronically to the Fedex warehouse, from which the items are shipped. This general trend towards simplification of physical distribution networks will allow goods to move directly from the manufacturer to the consumer, much like the system put in place for catalog shopping.2

LOGISTICS COORDINATION STRUCTURES

From an organizational perspective, coordination structures can be characterized as markets or hierarchies.23 Logistics processes such as purchasing, transportation, or warehousing can take place entirely within a firm or can involve a relationship between firms. When, for example, General Motors decides to manufacture axles in one of its own factories, we say the transaction takes place through a hierarchy. Had GM decided to contract with an outside supplier, we would characterize the acquisition as

using the market. Markets take on two configurations. Decentralized markets are "fully connected" structures where all sellers and buyers have a direct connection, i.e., there are no intermediaries involved. Centralized markets, on the other hand, use intermediate broker nodes to assist in coordination processes; for example, a prospective airline passenger uses a travel agent, who chooses the best price and schedule among those offered by the different airlines serving a given destination. The distinction between hierarchies and markets is a generic one, and indeed many transactions involve some combination of both, depending on the functions or products involved.
Benjamin and Wigand suggest that the development of the National Information Infrastructure will have two main impacts on the functioning of the value chain linking producers with intermediaries and consumers.24 The first impact will be a restructuring and redistribution of profits along the chain. Information technologies such as telemarketing, express delivery, and improved inventory forecasting have already reduced the need for local warehousing and distribution networks.25 Second, there will be an evolution from single-source channels (whether traditional or electronic) to electronic markets. Benjamin and Wigand assert that the widespread adoption of electronic markets will reduce physical distribution costs, partially through the elimination of intermediaries.26

The main impacts of electronic commerce on physical distribution have been the elimination of many of the barriers to entry formerly represented by distribution channels, an overall reduction in the cost of channel marketing accompanied by lower search and product costs for end users, and improved communications between end users, distribution channel operators, and manufacturers. Segal provides the following illustration of the impact of IT on physical distribution:

Staring at the mechanical drawing on his computer screen, an engineer recognizes the need for a new part to improve his product design. Rather than calling a distributor, the engineer connects to an on-line service that provides substantial information: a roster of vendors that can meet his technical specifications; a product list ranked by price; schematic diagrams, and tests results, product reviews, and comments from other engineers.

credit
invoices
paying bills

Satisfied with his information search, the engineer checks for the product's availability at a large, public warehouse and places an order for a sample. A bank affiliated with the on-line network extends credit if needed and electronically invoices the engineer's department. In turn, an EDI system pays the bill electronically. An express delivery firm delivers the part the next day.

A new customer/vendor relationship is established, but what (or where or who) was the channel of distribution?27

New information technologies are providing better support for human decision-making and supporting the creation of new types of nodes in the supply chain, making it appropriate to consider redesigning logistics structures. The tools that will support redefinition of logistics include information gathering, processing, and distribution techniques as well as communications technologies such as widespread broadband. networks. Empirical data suggests that firms using IT to redesign and integrate logistics processes are enjoying significant benefits, including reduced costs and much better customer service.28 For example, IT adoption is associated with wider spans of control for senior logistics executives, which supports better integration and coordination of different functions and departments.29

COMPARISON OF ALTERNATIVE LOGISTICS SUBSTRUCTURES

Traditional systems of logistics distribution involve processes that

operate by moving goods through a hierarchy, as shown in Figure 1. Goods are passed down the distribution network from the producer, through one or more distributors, to the retailer and final consumer. While most flows of goods are from the producer to the consumer, there are exceptions where the reverse is true. These include the recall of defective products, maintenance, repair, and returns of recyclable packaging. Information, in contrast, flows both ways. For example, the consumer sends an order to the distributor, who responds with an order confirmation notice which provides shipping information.

The information associated with the flow of goods has mostly been maintained on paper, and computerized information systems developed by each organization in the supply chain have not been connected to each other and capable of exchanging machine-readable data. Accordingly, information traditionally moves through the logistics structure in a manner quite similar to that of the goods associated with the information. With electronic distribution of information, such as through the adoption of EDI in purchasing, information flows can be separately optimized. It should therefore be possible to separate out the information flows associated with the goods distribution hierarchy to create a new information structure, shown in Figure 2, to support the physical flow of goods in Figure 1.

This view of information flows encompasses a wide variety of documents or messages throughout the logistics process. First, demand for a product must be established, through forecasts of purchase requirements or actual orders. Second, there is the order cycle itself, followed by distribution, receipt and **payment** . Third, supplier performance is evaluated and feedback provided. As will be discussed below, the objectives of the different participants in the supply chain often conflict, and intermediaries can play a role in resolving these differences.

(Illustration Omitted)

Captioned as: FIGURE 1

A separate optimization of information flows could therefore theoretically lead to a single-level hierarchy. This flat information substructure would usually not be optimal for the flow of goods, due to the constraints of transportation costs, capacity, and the need to break out shipments (such as whole truckloads) at intermediate warehouses for redistribution to customers. However, a flat information substructure would provide an efficient and responsive information flow.

(Illustration Omitted)

Captioned as: FIGURE 2

In Figure 2, the producer could own or control all data associated with that producer's products. This would minimize the decision information costs of keeping the producer informed of the status of the goods (whether ordered, in transit, delivered, or paid for), referred to in the messages passed through the information substructure. Decision information costs include data entry, transmission, and processing costs as information moves through the hierarchy up to the producer.

Our model, while conceptual, could be viewed as including carriers, brokers, financial institutions, and others involved in the flow of goods, even if those organizations do not come into physical contact with the goods themselves. Each party involved in the supply chain would generate, process, and receive different information. However, under the scenario envisaged in Figure 2, the producer node would act as the coordination point for the entire supply chain. Wal-Mart provides an example of a flat information structure that incorporates strategic alliances with suppliers, careful selection of store locations, a private trucking fleet, cross-docking at regional distribution centers, and EDI via satellite

communications among all the participants; the network is managed by Wal-Mart itself.30

However, it cannot be assumed that producers will always act in the best interests of consumers and others in the supply chain. The responsibility for balancing the needs of producers and consumers rests with intermediaries such as brokers and distributors. Sarkar, Butler, and Steinfield suggest that the advent of ubiquitous information infrastructures will lead to considerable opportunities for intermediaries rather than hasten their demise. The authors describe four possible outcomes of the current trend toward electronic commerce: a reinforcement of direct producer-to-consumer links, the use of the network by producers to bypass intermediaries and link directly to consumers, a reinforcement of an existing intermediary structure, and the emergence of new networkbased intermediaries. The new intermediaries (which the authors term "cybermediaries") could include directory and search services, virtual malls and resellers, web site evaluators, financial intermediaries providing online credit, and intelligent agents.3'

A flat information substructure would also reduce the number of information nodes through which information must pass, because the number of nodes falls as intermediate levels are eliminated and the span of control is increased. Additionally, there would be a reduction in response time as well as in communications and information processing costs for messages, as at most only two messages would be required to connect the producer and retailer. In a hierarchy, the number of messages required increases with the number of levels through which messages must be processed.

Another effect of a flat information substructure would be to minimize the agency costs associated with distributors or retailers who do not act in the producers' interests.32 For example, a common problem in the grocery industry occurs when products are discounted by the manufacturer with the expectation that the distributor will resell the goods in a specific region at a discount, perhaps in conjunction with an advertising campaign being conducted in the same region by that manufacturer. Often, the goods are diverted by the distributor to another region where the distributor can obtain the regular wholesale price. By introducing EDI and supporting the management of retail inventories by producers (or more simply by providing for the visibility of these inventories), the grocery industry is attempting to minimize agency costs.33

While the information substructure described in Figure 2 may be optimal from the viewpoint of information efficiency, the producer would be the sole coordination and processing node for all information associated with the physical flow of goods manufactured by that producer. However, the producer could easily be overwhelmed by the volume of data being received from every intermediary, retailer, or even final consumer, depending on the nature of the product.

Accordingly, introduction of an IT node (Figure 3) would offer the opportunity to minimize the number of connections and messages required, while inserting only one intermediate level of information processing. This additional node would allow for different bounded rationality compared to a human producer.34 The information substructure shown in Figure 3 would minimize decision information and agency costs while requiring only one additional connection compared to Figure 2-the link between the producer and the IT node. Agency on the part of all the participants in the structure could be reduced as this arrangement may provide better protection from the producer for distributors and retailers by having an electronic intermediary that is controlled by a consortium of participants.

A number of firms have undertaken similar strategies in separating and optimizing information and goods substructures. For example, the airline industry moves information through electronic networks while distributing

passengers via hubs, or hierarchy-like structures. Financial institutions exchange credit information via a centralized broker (a credit reporting agency) while the money (which is the good in this case) is distributed through a different substructure.

(Illustration Omitted)

Captioned as: FIGURE 3

As mentioned previously, Wal-Mart no longer manages its shelves of Procter & Gamble products because P&G acts on consumer information derived from retail transactions at Wal-Mart stores. This allows Wal-Mart to alter its distribution strategies, resulting in competitive advantage. Although retail transactions are generated and owned by retailers at this time, the ownership of that information may eventually migrate to a different set of intermediaries or "cybermediaries." Either producers or third-party intermediaries currently control the information within the structures that are examples of the separation and optimization of the movement of goods and information.

The hub-and-spoke systems operated by major airlines for the purpose of passenger delivery represent the physical flow substructure. Both passengers and cargo are routed (in a hierarchical manner) through hubs to reach their destinations. However, the associated information (such as reservations) flows through a completely different set of paths and networks. The communications paths and location of the information nodes are independent of the physical distribution substructure. The information substructure for airlines resembles a centralized market structure where a producer/airline owns and controls the access to and the distribution of the actual data. The centralized location of information is efficient in its own right and allows airlines to have better control over the optimization of the physical flows. The airline's route network and its data communications and processing requirements, while related, are managed and optimized separately.

Credit reporting agencies provide an information substructure between financial institutions and consumers; that substructure resembles a centralized market. The distribution of money or goods does not take place within the same structure. In fact, the coordination structure for credit information is a decentralized market where each consumer has access to a variety of financial institutions. Within this example, separation of the substructures yields additional efficiencies such as competition and better information availability. Interestingly, within this scenario, restructuring of conventional information gathering techniques through centralization has occurred; however, the paper-based system of **payment** has only begun to be converted to an electronic one.

As mentioned previously, Wal-Mart has its own distribution substructure for the physical delivery of its products. The separate information substructure enables Wal-Mart to alter these distribution strategies, resulting in competitive advantage. The fact that many major Wal-Mart suppliers have direct access to point-of-sale retail information allows for more competitive production and distribution strategies.

OPTIMIZATION OF LOGISTICS SUBSTRUCTURES

If coordination of logistics activities is separated into physical and information substructures, it becomes feasible to optimize each substructure independently. Doing so may lead to a new overall structure and strategy that may have not been achieved with the traditional view of logistics. New levels and expectations for logistics performance may be reached via this separation into substructures as each of them is individually optimized according to a distinct set of criteria. Each of the two substructures can benefit from and respond to the new technologies and

changes in the environment.

The information substructure will benefit from information technologies that can yield a flatter distribution structure requiring fewer intermediate stages where time and cost are added. The same effect is taking place in the form of downsizing and delayering in many organizations.35 A reduction in the supplier base may also result.' In fact, a new form of information substructure may resemble an electronic or computer-mediated market where all buyers and suppliers of goods communicate via an IT node rather than a human broker or agent.37 The delivery substructure for physical goods, on the other hand, may face its own form of downsizing and delayering, as a second-order effect. These changes will lead to reduced overall costs and a shift in the distribution of costs between the various logistics activities such as order processing, warehousing, shipping, delivery, and **payment** .38 Each substructure has a different set of constraints and should be optimized independently.

The information substructure has traditionally required the presence of nodes in physical proximity to customers, which often limited many firms to operating in large cities. With recent improvements in IT, the location and movement between information substructure nodes with respect to physical location of goods is becoming less important. The delivery substructure, however, remains dependent on the locations of the actual production and warehousing facilities and the cost of moving products.

CONCLUSION

The above concept of alternative logistics coordination structures could assist organizations with the redesign of their physical distribution and associated IT processes. However, further analytical proof will be required to define the alternatives and opportunities for logistics coordination in light of the new technologies.

Additionally, there exists an opportunity to use coordination structures to represent logistics processes and to support the exchange of information about those processes with other disciplines.39 Such exchanges would be particularly relevant given the impact of IT on logistics activities.

Supply chain management and cycle time compression have emerged as complementary but central strategies in logistics management. Globalization, uncertainty, and downsizing are contributing to the increased visibility of logistics functions within and between organizations. To be effective, logistics processes such as just-in-time delivery require effective IT support-for example, through the timely transmission of accurate shipment information before the goods physically arrive.4' Gains from innovations such as just-intime delivery depend on real-time sharing of information between buyers and suppliers.42

Effective coordination of logistics activities is essential to organizational performance. However, for improved coordination to be possible, IT must play a larger role than simply providing status information on existing flows of goods.43 Certainly, the information substructure can be optimized and configured separately from the physical goods delivery system. But management must both optimize the flow of goods and develop the IT infrastructure that will support renewed logistics processes.

Footnote:

NOTES

'Thomas W Malone and Kevin Crowston, "The Interdisciplinary Study of Coordination," ACM Computing Surveys 26, no. 1 (March 1994): 87-119. 2Same reference as Note 1.

3Questions and Answers about the MIT Center for Coordination Science, available at <http://ccs.mit.edu>.

~~aSame reference as Note 1. See also Thomas W Malone, Kevin Crowston,~~ Jintae Lee, and Brian Pentland, "Tools for Inventing Organizations: Towards a Handbook of Organizational Processes," Proceedings of the Second Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises, 2>22 April 1993. Los Alamitos, Calif.: IEEE Computer Society Press, 1993.

5Donald J. Bowersox and Patricia J. Daugherty, "Logistics Paradigms: The Impact of Information Technology," Journal of Business Logistics 16, no. 1 (1995): 65-80. 6Haydee S. Sheombar, "EDI-Induced Redesign of Coordination in Logistics," International Journal of Physical Distribution and Logistics Management 22, no. 8 (1992): 4-14.

7Paul D. Larson, "An Empirical Study of Inter-Organizational Functional Integration and Total Costs," Journal of Business Logistics 15, no. 1 (1994): 153-169. 8Craig M. Gustin, Patricia J. Daugherty, and Theodore P Stank, "The Effects of Information Availability on Logistics Integration," Journal of Business Logistics 16, no. 1 (1995):1-21.

9Michael A. McGinnis, Sylvia K. Boltic, and C.M. Kochunny, "Trends in Logistics Thought: An Empirical Study," Journal of Business Logistics 15, no. 2 (1994): 273-303. "Douglas M. Lambert and James R. Stock, Strategic Logistics Management (Homewood, Ill.: Richard D. Irwin, 1993), p. 4.

"Ronald D. Henkoff, "Logistics: Delivering the Goods," Fortune, 28 November 1994, pp. 64-78.

12 Christopher Gopal and Gerard Cahill, Logistics in Manufacturing (Homewood, Ill.: Business One Irwin, 1992), Chapter 1.

'Perry A. Trunick, Helen B. Richardson, and Lisa Harrington, "CLM: Breakthrough of Champions," Transportation and Distribution 35, no. 12 (December 1994): 41-50. 14 Jeffrey F Rayport and John J. Sviokla, "Exploiting the **Virtual** Value Chain," Harvard **Business** Review 73, no. 6 (November-December 1995): 75-85. '5Same reference as Note 14.

Footnote:

16 J. Yannis Bakos and Erik Brynjolfsson, "Information Technology, Incentives, and The Optimal Number of Suppliers," Journal of Management Information Systems 10, no 2 (Fall 1993): 31-52.

"Joint Industry Project on Efficient Consumer Response, ECR Alliances: A Best Practices Model (Washington, D.C.: Grocery Products Manufacturers of America, 1995). 'Same reference as Note 4.

SG. N. Evans, M. M. Naim, and D. R. Towill, "Dynamic Supply Chain Performance: Assessing the Impact of Information Systems," Logistics Information Management 6, no. 4 (1993): 15-25.

2Michael E. Porter, The Competitive Advantage of Nations (New York: The Free Press, 1990), p. 3.

2"Robert I. Benjamin and Rolf T. Wigand, "Electronic Markets and Virtual Value Chains on The Information Highway," Sloan Management Review 36, no. 2 (Winter 1995): 62-72.

22Rolf T. Wigand and Robert I. Benjamin, "Electronic Commerce: Effects on Electronic Markets," Journal of Computer-Mediated Communication 1, no. 3 (December 1995). Available at <http://www.usc.edu/dept/annenberg/vol1/issue 3/wigand.html>. 23Thomas W Malone, "Modeling Coordination in Organizations

and Markets," Management Science 33, no. 10 (October 1987): 1317-1332. 24Same reference as Note 21.

2"Robert L. Segal, "The Coming Electronic Commerce (R)evolution," Planning Review 23, no. 6 (November-December 1995): 21-27, 45. 26Same reference as Note 21. 'Same reference as Note 25.

28 Edward J. Bardi, T.S. Raghunathan, and Prabir K. Bagchi, "Logistics Information Systems: The Strategic Role of Top Management," Journal of Business Logistics 15, no. 1 (1994): 71-83.

29Richard Germain, Cornelia Droge, and Patricia J Daugherty, "A Cost and Impact Typology of Logistics Technology and The Effect of Its Adoption on Organizational Practice," Journal of Business Logistics 15, no. 2 (1995): 227-248.

3George Stalk, Philip Evans, and Lawrence E. Shulman, "Competing on Capabilities: The New Rules of Corporate Strategy," Harvard Business Review 70, no. 2 (March-April 1992): 57-69.

31 Mitra Barun Sarkar, Brian Butler, and Charles Steinfield, "Intermediaries and Cybermediaries: A Continuing Role for Mediating Players in the Electronic Marketplace,"

Footnote:

Journal of Computer-Mediated Communication 1, no. 3 (December 1995). Available at <http://www.usc.edu/dept/annenberg/vol 1/issue3/sarkar.html>.

3Vijay Gurbaxani and Seungjin Whang, "The Impact of Information Systems on Organizations and Markets," Communications of the ACM 34, no. 1 (January 1991): 59-73. 33Same reference as Note 17.

34Herbert A. Simon, "Bounded Rationality and Organizational Learning," Organization Science 2, no. 1 (1991): 125-134.

35William E. Halal, "From Hierarchy to Enterprise: Internal Markets are The New Foundation of Management," Academy of Management Executive 8, no. 4 (November 1994): 69-83.

36 Same reference as Note 16.

3'Thomas W Malone and Stephen A. Smith, "Modeling the Performance of Organizational Structures," Operations Research 36, no. 3 (May-June 1988): 421-436. 38Same reference as Note 21. 39Same references as Notes 1 and 9.

4Bernard J. La Londe and James M. Masters, "Emerging Logistics Strategies: Blueprints for The Next Century," International Journal of Physical Distribution and Logistics Management 24, no. 7 (1994): 35-47. 4'Same reference as Note 6.

"Kannan Srinivasan, Sunder Kekre, and Tridas Mukhopadhyay, "Impact of Electronic Data Interchange Technology on JIT Shipments," Management Science 40, no. 10 (October 1994):1291-1304. 43Same reference as Note 14.

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...TEXT: in order to create better information, which in turn should support lower inventories and improved **financial** performance. But the evolution of IT and diminishing **transaction** costs will also lead to a fundamental restructuring of industry practices for distributing and supporting...

... and the flow of information related to those goods, such as purchase orders, waybills, and **payments** . The nodes or decision-making points linking the points represent the different participants, such as...sample. A bank affiliated with the on-line network extends credit if needed and electronically **invoices** the engineer's department. In turn, an EDI system pays the bill electronically. An express...

... or actual orders. Second, there is the order cycle itself, followed by distribution, receipt and **payment** . Third, supplier performance is evaluated and feedback provided. As will be discussed below, the objectives ... of conventional information gathering techniques through centralization has occurred; however, the paper-based system of **payment** has only begun to be converted to an electronic one.

As mentioned previously, Wal-Mart...

... of costs between the various logistics activities, such as order processing, warehousing, shipping, delivery, and **payment** .38 Each substructure has a different set of constraints and should be optimized independently.

The... 12 (December 1994): 41-50. 14 Jeffrey F Rayport and John J. Sviokla, "Exploiting the **Virtual** Value Chain," Harvard **Business** Review 73, no. 6 (November-December 1995): 75-85. '5Same reference as Note 14.
Footnote...
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